

GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations, Phase I

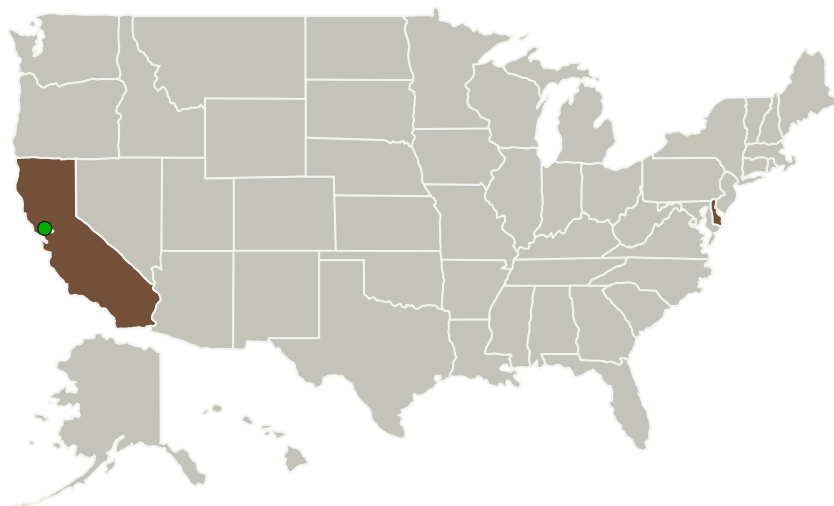
Completed Technology Project (2010 - 2010)



Project Introduction

Many large-scale numerical simulations can be broken down into common mathematical routines. While the applications may differ, the need to perform functions such as matrix solves, Fourier transforms, or eigenvalue analysis routinely arise. Consequently, targeting fast, efficient implementations of these methods will benefit a large number of applications. Graphics Processing Units (GPUs) are emerging as an attractive platform to perform these types of simulations. Their FLOPS/Watt and FLOPS/dollar figures are far below competing alternatives. In previous work, EM Photonics has implemented dense matrix solvers using a hybrid GPU/multicore microprocessor approach. This has shown the ability to significantly outperform either platform when used independently. In this project, we will develop a complimentary library focused on performing routines on sparse matrices. This will be extremely valuable to a wide set of users including those doing finite-element analysis and computational fluid dynamics. Using GPUs, users are able to build single workstations with an excess of four teraFLOPS of computational power as well as create large, high-performance computing systems that are efficient in terms of both cost and power. By leveraging libraries such as the ones we will develop for this project, the user is shielded from the intricacies of GPU programming while still able to access their computational performance.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
EM Photonics, Inc.	Lead Organization	Industry	Newark, Delaware
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Delaware

Project Transitions

▶ **January 2010:** Project Start

✓ **July 2010:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140052>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

EM Photonics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

John R Humphrey

Co-Investigator:

John Humphrey

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Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
 - └ TX11.3 Simulation
 - └ TX11.3.5 Exascale Simulation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System